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New Assessment Could Change Alaska Focus

NPR-A Looking Good After Study

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The National Petroleum Reserve-Alaska (NPR-A) could offer enormous potential for frontier exploration, plus one important advantage:

It isn't ANWR.

In May, the U.S. Geological Survey will release a new NPR-A resource assessment, with estimates of undiscovered oil and gas and descriptions of known plays - a study that is sure to raise the industry's awareness of the area.

It might raise a few eyebrows, as well.

With several promising oil plays, a likely conventional gas resource and significant potential for coalbed methane production, NPR-A may become the focus for future Alaska drilling.

After the USGS releases its resource assessment in Washington, D.C., it will provide a detailed review May 19-22 at the AAPG/SPE Pacific Regional Conference in Anchorage.

The Survey plans more than 30 presentations at the meeting, including papers, posters and core workshops. Ken Bird, USGS project chief in Menlo Park, Calif., will summarize the study.

NPR-A is "a dream province to work in for a geologist like me," said David Houseknecht, USGS research geologist in Reston, Va., "because it is one of the few onshore provinces in North America that still has the potential for 100-500 million barrel accumulations to be discovered, and where you can still make significant contributions by putting together regional studies."

Geologists examine shallow marine strata of Lower Cretaceous Nanushuk Formation about 40 miles west

A Huge, Diverse Region

In June, the U.S. Bureau of Land Management will hold a lease sale on about four million acres in NPR-A's northeast corner.

BLM currently is preparing an EIS for another area, on acreage just to the west, where a lease sale may be held as early as 2004. Houseknecht described an earlier NPR-A lease sale in May 1999 as "highly successful," generating over $100 million in winning bids for about 870,000 lease acres.

Covering more than 36,000 square miles, NPR-A extends along and inland from the northern coast of Alaska. Point Barrow is roughly a centerpoint at its north, and the Brooks Range of mountains a limit to its south.

"NPR-A is such a huge area that it encompasses everything from the northern front of the Brooks Range to a broad foothills belt that represents the surficial expression of the thrust belt, to a marshy coastal plain," Houseknecht said.

Geologically it is very diverse, he added, with rocks from Mississippian in age ranging up to late Cretaceous in age

"In vast areas of NPR-A there is essentially no well control," Houseknecht said. "It is truly a frontier province where regional studies matter, where outcrop work still has significance."

He said the USGS has been working on the current NPR-A project for almost four years. The most recent previous resource assessment of the Reserve was released in 1980.

Included in the new NPR-A assessment will be:

- Probabalistic estimates of in-place and technically recoverable resources for each play and the entire NPR-A.
- Estimates of economically recoverable oil and gas resources.
- Digital maps of each play.
- Distribution of accumulation sizes for each play.

Houseknecht said a six-page color fact sheet will be distributed on the mid-May release date, with a more detailed "e-bulletin" subsequently accessible through the USGS Web site at www.usgs.gov.

Local Support

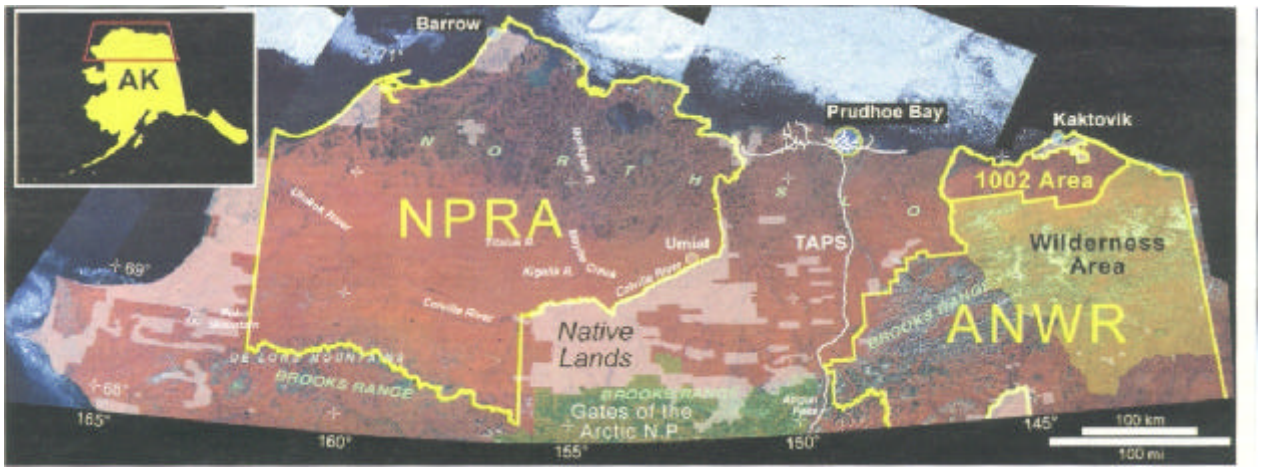
NPR-A has a similar climate to ANWR, but not the intense political heat. Opening most of its area for exploration may be viewed favorably by policy makers.

It's already supported by the people who live there.

Richard Glenn, vice president-land for the Arctic Slope Regional Corp., lives in Barrow, Alaska. He holds a master's degree in geology from the University of Alaska at Fairbanks.

Glenn also serves as co-captain of a Barrow whaling crew, the Savik Ahmaogak Crew.

"The North Slope people



A geographical setting of the National Petroleum Reserve-Alaska (NPR-A): At 23 million acres, or 36,000 square miles, it's about the size of the state of Indiana. The Arctic National Wildlife Refuge (ANWR) comprises 19 million acres, or 30,000 square miles, and is about the size of South Carolina. The 1002 Area holds 1.5 million acres, or 2,300 square miles, about the size of Delaware.

have advocated for safe, responsible onshore exploration," Glenn said. "Our municipality tax base depends on the tax revenue generated from oil and gas infrastructure.

"The revenue has built schools, health clinics, fire halls and other community necessities in our villages," he continued. "The industry represents one of the few places where our people can work in our region, which lacks agriculture, commercial logging or fishing, or other economic bases."

Growing interest in exploring NPR-A "tests our mettle," said Glenn, whose mother was born in Barrow and is an Inupiaq Eskimo. He was born in California and returned to Barrow as a youngster.

"Our culture has been changing for centuries," he said. "Exploration success in NPR-A is bound to change things. Some for the better, and others for the worse. We believe that on balance, the advantages outweigh the disadvantages."

One advantage favoring NPR-A development stems from its designation as a petroleum reserve, not a "wildlife refuge."

Glenn observed that both NPR-A and ANWR host wildlife resources and also offer millions of acres of geologic potential.

"NPR-A is a petroleum reserve and so carries much less of the mythic trappings that the 1002 Area of the ANWR coastal plain has," he said.

In truth, on the surface there is little difference between the coastal plain of NPR-A and the coastal plain of ANWR," he added. "Both areas lie within the traditional homeland of our Inupiat people, with camps and settlements up nearly every river drainage along the coastline."

Glenn observed that northern Alaska first attracted exploration interest more than 100 years ago. The USGS began studying the area in 1901, drawn there in part by the discovery of oil seeps.

In 1923, the Federal government set aside a sizeable expanse as Naval Petroleum Reserve Number 4. The Navy sponsored two multiyear exploration programs in the Reserve, the first spurred by World War II and the second by the Prudhoe Bay discovery and the Arab oil boycott.

After almost 50 test wells, the Umiat Field, discovered in 1946, remained the largest known oil accumulation in the Reserve at 70 million barrels. The area became a National Petroleum Reserve in 1976, with the USGS responsible for further research and evaluation.

Additional exploration took place in the 1980s following BLM lease sales. No commercial discoveries resulted from the effort, though Houseknecht noted that one well, the Chevron Livehorse, is still a tight hole after 20 years.

After some offshore disappointments, industry interest in northern Alaska and NPR-A waned. Arco Alaska attempted exploration just to the east of NPR-A in 1994-95, targeting a turbidite prospect near the Colville River Delta.

That try also failed, Houseknecht said, but Arco decided to drill deeper for a look at sands in the Kingak shale. It found the Alpine reservoir.

Alpine Success

Estimates of Alpine oil reserves range up to 430 million

Left, the Lisburne well, drilled within the NPR-A in 1979; right, a sandstone bluff of Lower Cretaceous Nanushuk Formation on Poko Mountain, about 15 miles west of NPR-A.

barrels, and Houseknecht said the reserve estimates are expected to increase, based on current production rates. It's high quality oil, at 40 degrees API gravity.

Phillips Petroleum became operator of the Alpine field when it acquired Arco's Alaska holdings. Alpine production began in late 2000 and, through a series of improvements, subsequently reached 100,000 barrels per day.

"The size of the reservoir and the nature of the oil discovered there came as a surprise even to the industry, because a reservoir of this quality was previously not known in that formation," Houseknecht said.

Phillips later announced two Alpine satellite discoveries.

In Fiord, five miles to the north, one of two initial wells tested at 2,500 barrels of oil per day. A test well drilled at Nanuq, six miles to the south of Alpine, produced 1,750 barrels of oil and 1.2 million cubic feet of gas per day.

Phillips said it plans to begin production from both areas when processing capacity becomes available at Alpine. Anadarko Petroleum holds a 22 percent interest in Alpine and the satellites, and is an active driller in the area.

A Brookian turbidite play, also just to the east of NPR-A, already has led to discovery of the Tarn oil field, with an estimated 70 million barrels of reserves, and the Meltwater field, with 50 million barrels. After two recent drilling seasons. Phillips Alaska announced last May that all of their NPR-A exploration wells but one tested oil and gas and could be commercial," Houseknecht said.

"Collectively, all of this success has resulted in tremendous industry interest, because it is known based on our work and the work of others that these plays extend westward into NPR-A," he added.

Houseknecht identified three promising plays that extend into and across the Reserve:

- **T** A Beaufortian Upper Jurassic Topset play (Alpine).
- **T** A Brookian Clinoform play (Tarn).
- **T** A Torok structural play to the south.

"During field work in support of our assessment, we discovered and described an oil-stained, amalgamated sandstone succession - probably a channelized turbidite system - that we were able to trace for about 12 miles along strike," he said. "The main body of the oil-stained sandstone is about 300 feet thick."

Exploration success in the NPR-A area has resulted from the 3-D seismic identification of subtle stratigraphic traps as well as "integrated, interdisciplinary geoscience analysis," he observed.

"These reservoirs are fine-grained in subtle stratigraphic traps," Houseknecht noted. "Sequence stratigraphy is important.

"It's also vary important to understand the geochemistry of the source rocks and the migration history of the hydrocarbons," he added, "because it can increase your probability of commercial discovery."

Target: Coalbed Methane

In addition to its potential for conventional oil and gas accumulations, NPR-A offers the promise of substantial coalbed methane production.

"The North Slope is probably the largest coal basin in North America," said Charles Barker, research geologist for the USGS in Denver.

"I've been working in Alaska since 1997," he said. "The problem is there's no data about the gas content of the coal.

"It's known that when the coal is penetrated, you get a gas kick," he continued. "They're extremely low-ash coals, in the order of 5 percent. Consequently they develop common cleat at low rank, and cleat permeability is essential to coalbed methane production."

Using worldwide averages for coal of the same rank as NPR-A, Barker estimated the area might have 200 trillion cubic feet of gas in place. He said the Reserve's coalbeds are within the normal development range for coalbed methane, up to 4,000 feet in depth.

Barker hopes to begin a two-year project to drill 4,000 to 5,000 feet deep slimhole test wells for coal gas in NPR-A.

"With helicopter support

it's very rapid, about two weeks per well," he said. All he needs is funding.

Drilling with helicopter support costs about $100 per foot, Barker estimated. He added that "helicopters are expensive."

"We're going up this summer to put stakes in the ground where we want to drill, and then start the permitting process. We have money to do that," he said.

If the test wells are funded and completed over a two-year period, an initial assessment of NPR-A coalbed methane resources could be completed within a few months of acquiring the final data, Barker said. Effective pipeline planning depends on a good understanding of all the gas resources in place, he noted.

"Because it's so isolated up there, it's a stranded market.

"Interest is rising because if they put in the gas pipeline, coalbed methane would be eligible to be produced to that," he explained. "Underdesign of the pipeline could strand gas up there for decades."

Development extent "depends on how much land you want to disturb," Barker said, citing the controversy over ANWR. "But this is an actual petroleum reserve."

Delicious Potential

Jim Clough is head of the Energy Resource Section of Alaska's Geological and Geophysical Survey. He thinks there's an excellent chance of producing NPR-A's coalbed methane resource.

"Personally, I'm very optimistic that it can and will be developed, probably much more readily than the coal will be developed." he said. "It's a lot easier to extract the gas."

Clough estimated North Slope coal resources at 3.7 trillion short tons.

"That's hypothetical," he commented, "but every time they've drilled into the west in the Deadfall syncline, the numbers hold."

With that kind of coal resource, the potential for coal gas can't be ignored, he said. It's a major attraction for energy development.

"They ought to consider the fact that down the road they may be able to produce at least 10 percent of this 800 Tcf of gas estimated on the North Slope. So there's another 80 Tcf of gas that could go down that pipeline," he said.

No one doubts that oil will drive the industry's expansion into NPR-A. Gas resources, both conventional and non-conventional, could bolster that interest, however.

"The farther west they go, the higher the gas potential is for the coalbed methane, because the coals are thicker and they're higher rank," Clough explained.

Even without the methane, NPR-A provides numerous exploration targets, with possibilities for production in almost every part of the Reserve.

"I think there's a tremendous potential for conventional oil and gas. Frankly, I think it's as good an oil play as it is a gas play. It will be dominantly stratigraphic traps," said Gil Mull, petroleum geologist for Alaska's Division of Oil and Gas.

"When you get down to the southern area the plays are going to be gassier, down in the foothills of the Brooks Range," he said. "When you go into the extreme southern part, you're in the thrust belt."

Recent work indicates that hydrocarbon potential across NPR-A might be more promising than believed earlier, according to Mull.

"We've found a belt with lower thermal maturity than we'd previously thought - really rich, good Upper Triassic to Middle Jurassic source rock," he said. "Clearly some of those oily source rocks were in the basin and in the cooker."

Mull also expects exploration to spread westward into NPR-A, though he said it may be slowed for at least three reasons:

- Companies will move further from existing infrastructure as they move
- Gravel and other construction materials may be a problem to the west.
- Lack of pipeline transportation will be a limiting factor.

Ultimately, development will depend on economics. Mull noted that the industry already has started committing more resources to exploration groundwork.

"There's a lot of 3-D seismic being shot out there." he said. "The resolution with that 3-D seismic is absolutely awesome to me."

Challenges and Endorsement

While NPR-A appears promising geologically, its remoteness, frontier nature and subtlety make economic exploration a question mark.

It's the type of region where dry holes are sure to be drilled, and sure to be expensive.

Over-regulation or expensive requirements may tip the balance away from resource development.

Glenn said NPR-A exploration presents logistical problems "that haven't been

experienced in the Prudhoe Bay area for some time."Well locations are scattered along a 150-mile swath covering the area's northern and eastern edge, he noted.

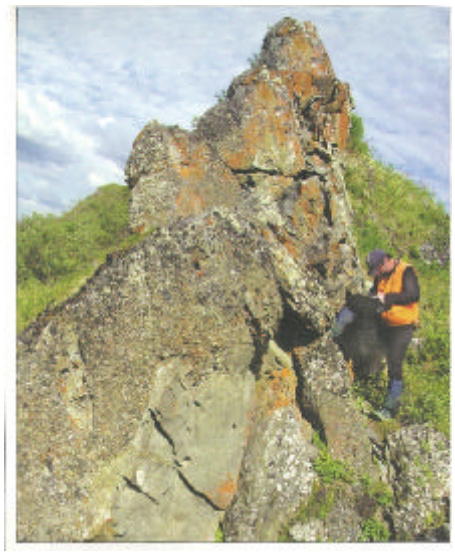
"At the farthest-flung locations, the companies would have timing and supply issues, not to mention the lack of additional support infrastructure," Glenn said.

"The companies must make every wellsite as self-contained as possible. A rig will be stacked over the summer west of Teshekpuk Lake on an insulated ice pad, for instance, because it takes too long to wait for winter travel conditions to allow rig transport from the Prudhoe Bay area."

AAPG has published a policy statement on NPR-A:

"It is in the best interest of the United States to allow exploration and development activities in NPR-Alaska, one of the most prospective areas of the country," it says.

"AAPG not only supports the full leasing of the NPR-A area, including the coastal plain, but supports regulations. and stipulations which allow for timely, economic and environmentally sound exploration and development activities in the area."•



A geologist at work in Alaska examines conglomerates in Cobblestone Sandstone member of the Fortress Mountain Formation. The large tan block is a clast of sandstone in conglomerate. This site is in the Brooks Range foothills, about 80 miles southeast of Umiat.